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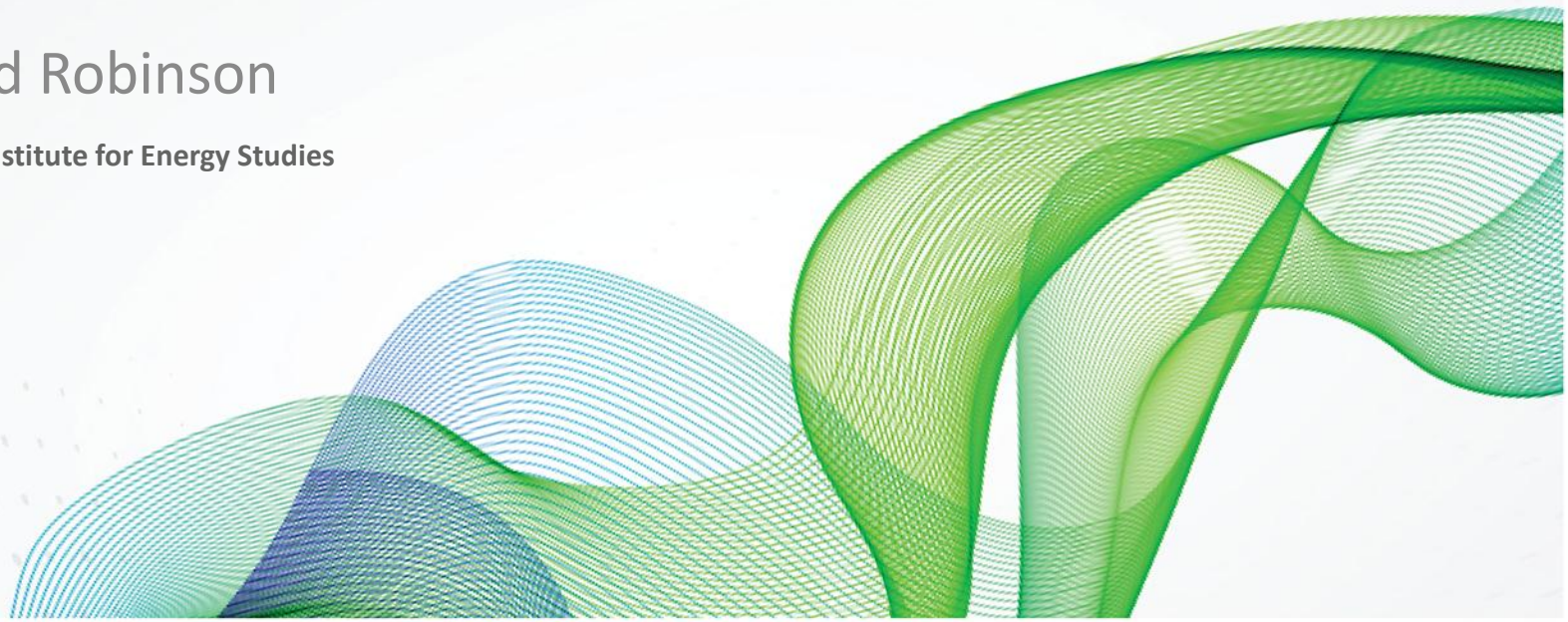
Electricity markets are broken; can they be fixed?

David Robinson

Oxford Institute for Energy Studies



Structure

1. Symptoms
2. Diagnosis
3. Possible solutions

The electricity industry is “turning upside down”

	NOW	FUTURE
Cost structure	Mainly marginal	Mainly capital
Pricing	kWh	?
Planning and operation	Flex supply to match demand	Flex demand to match supply
Control and dispatch	From centre	Throughout system (cf internet)
Role of demand-side	Passive	Interactive
Role of grids	Neutral conduit	Smart player

Symptoms

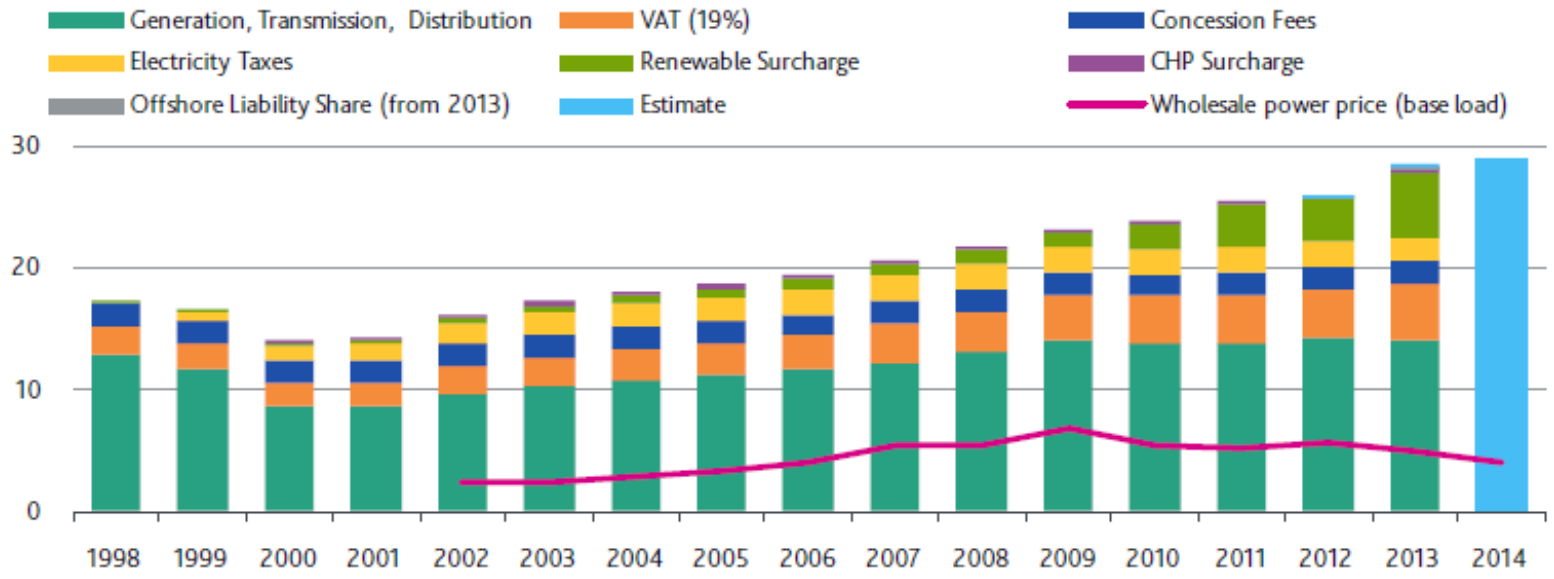
1. Declining wholesale market prices across Europe
   - Supported RES depress wholesale price
   - Costs are loaded onto consumers, widening gap - wholesale and retail prices
2. Flattening of the intraday price curve
   - Because of increased RES (esp. PV) penetration
   - Dis-incentivises demand response and lowers margins.
3. Frequent occurrence of zero or negative prices
   - Needed to balance the system, but also reflect distortions
4. Major hit for the utilities
   - Slow growth
   - Declining prices and margins
   - Declining market shares
   - Unprofitable plants closure often forbidden by Regulator
   - But utilities are expected to massively invest in new power system.

Retail and wholesale prices diverge

EXHIBIT 9

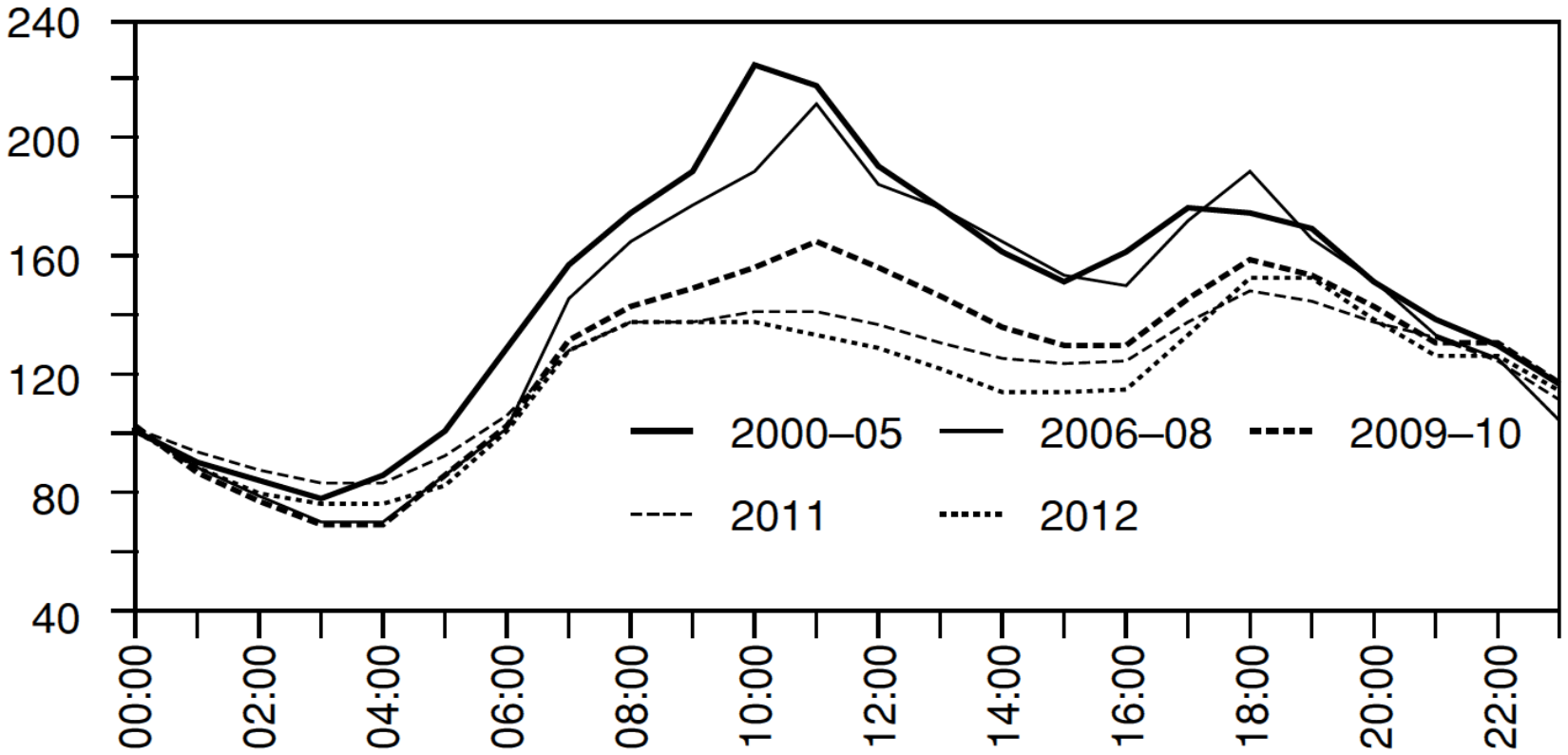
Disconnect between wholesale and retail electricity prices in Germany

€cent/kWh

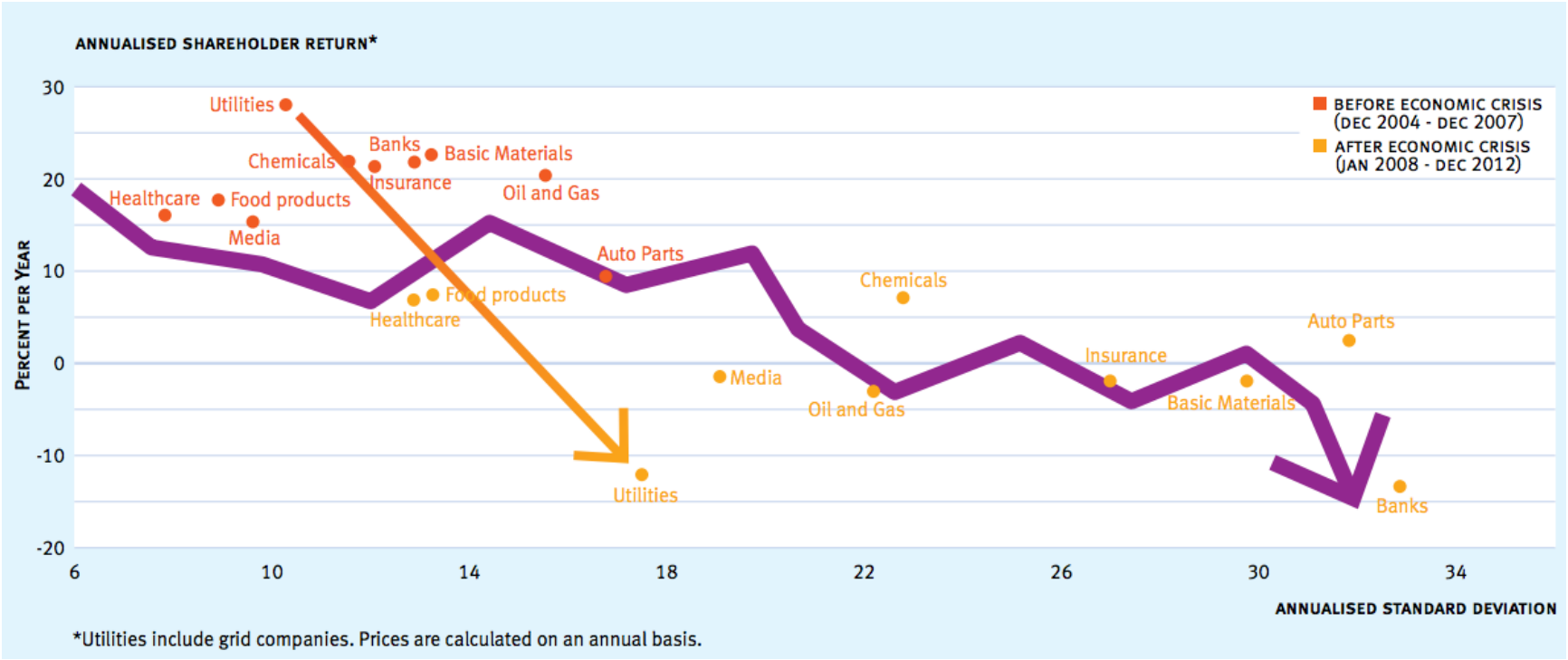


Source: BDEW, Moody's

Intraday price in Germany – where are the signals for DR?



European electric utility shareholder returns

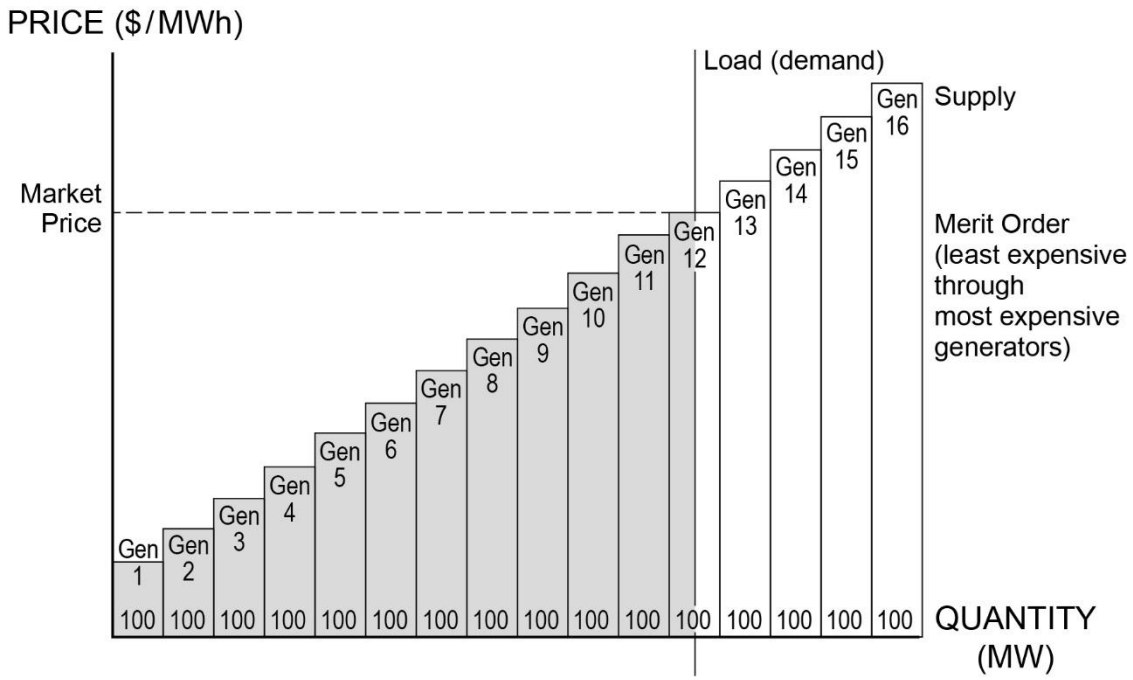


*Utilities include grid companies. Prices are calculated on an annual basis.

Diagnosis

- Current (energy only) market design reflects 20th century technologies and industrial structure.
- Current (energy only) market design does not reflect 21st century technologies or competitive environment.
- A new market model is needed.

The traditional view of wholesale electricity markets



There were always problems – but they were manageable

- Many system and generation costs fixed – do marginal costs give the right signals for investment?
- Clustering and herd behaviour – can markets produce diversity?
- Consumer prices – few signals to guide behaviour.

But with the penetration of intermittent renewables the problems become unmanageable

1. The cluster is often at zero; no signals for operation
2. Poor signals for investment; markets automatically limit renewables penetration.
3. No exit strategy; price distortions permanent.
4. No useful signals for demand-side. Consumer price signals administratively determined – yet demand flexibility is now a priority.
5. No system optimisation.

Possible solutions

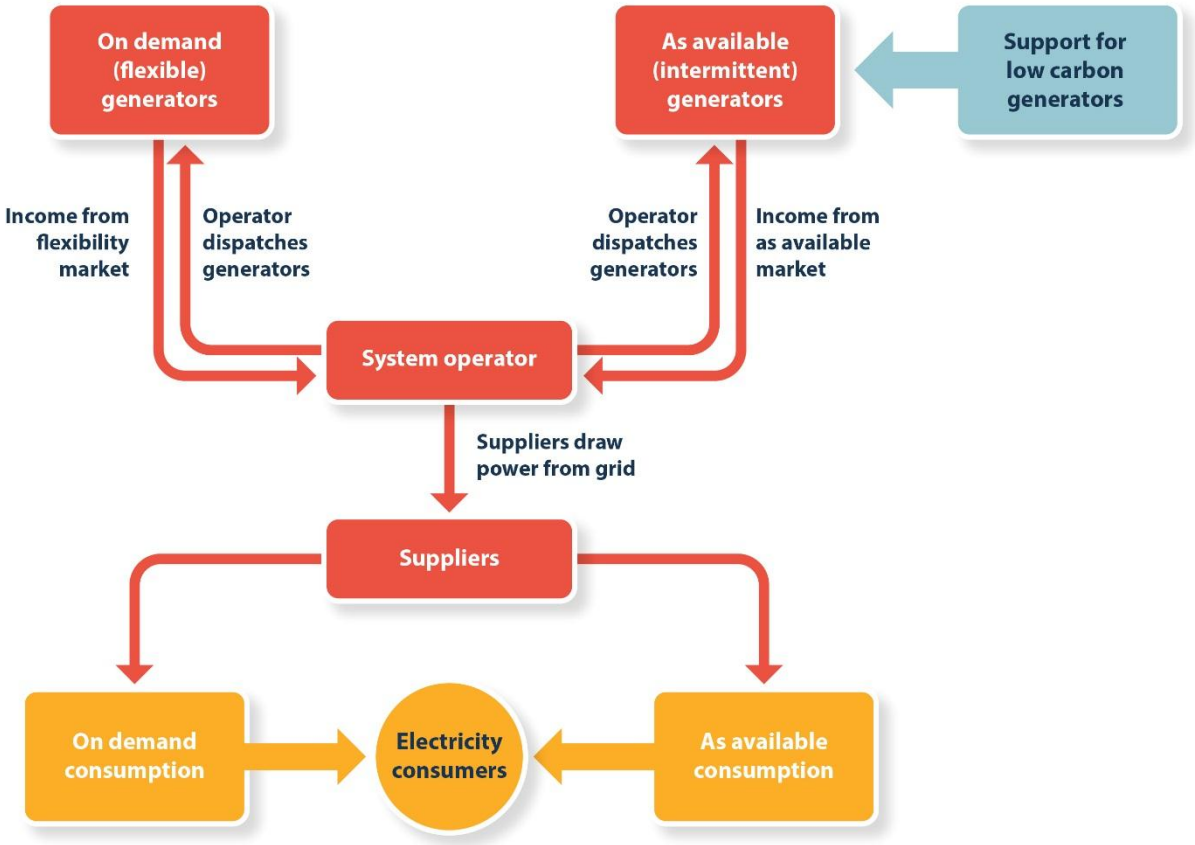
- Stop supporting renewables
- Central planning
- ToU pricing + refinements to energy only market
- Fixed cost elements
- Transactive pricing
- Capacity/investment markets
- Two market approach

The two market approach

Principle: separate 'on demand' and 'as available' markets
This version separates markets both in generation and retail

- On demand consumption: high price/high reliability (SO dispatch on demand generation to match consumption, as now).
- As available consumption: low price/low reliability (can be curtailed as needed to balance as available generation, made possible by smart meters and the like).
- On demand price set by markets, as now.
- As available price might initially be set administratively; the long run should pass through to consumers from the as available market. The aim would be that prices would reflect *long run marginal costs .*
- Generators choose in which market to participate.
- Separate metering (on demand and as available) consumers could choose when to forego on demand consumption.
- Intended to foster demand side response and develop consumer supply chain.

The two market approach on generation and retail sides



Some considerations

- Better signals for operation for flexible plants (marginal approach in on-demand market)
- Removes market distortions in the flexible market
- Creates an exit strategy, RES can move to the on demand market if there is enough control/flexibility/storage/carbon prices/ …
- Creates effective signals for investment in flexible generation, and move towards effective ones in RES generation.
- Allows governments to consider long-term optimization on the basis of proper understanding of demand response.
- Incentivizes demand response and storage development.

THIS VERSION

- Involves radical change.
- Implies government intervention (central balancing, market and pricing structures).
- Oversimplifies consumer offer, at least initially.

THERE ARE OTHER VERSIONS THAT ARE SIMPLER AND COMMERCIALLY ATTRACTIVE.

Conclusions

- Electricity markets in Europe are broken; they are not fulfilling their basic functions.
- They are based on 20th C technologies and systems; new thinking is needed for the 21st C.
- There is a large number of possible options – all have their advantages and disadvantages.
- The main thing now is to start discussing and refining the options.

Camino Alto 13,
Alcobendas, 28109, Madrid
david@davidrobinsonassociates.com
+34 619022575
www.davidrobinsonassociates.com

EXTRA SLIDES

Drop support for renewables

- Should keep penetration below levels that grossly distort prices, BUT
- Europe will likely miss 2030 targets
- Risks leading to a sub-optimal system, as RES cost decreases and traditional generation cost increases
- But could support renewables in different ways, using economic instruments

Central planning

- Back to the “old world” of regulated utilities
- Compatible with some market elements (e.g. auctions for procurement of new generation)
- More effective coordination, less transaction costs, easier geographical aggregation, long-term perspective encouraged
  - ➢ The central planner (the Ministry or an expanded TSO-like entity) would plan and operate the system
- Huge efficiency incentives reduction, inflexible and conservative structure, subject to greater political pressure, higher risk for consumers and/or taxpayers
  - ➢ That is, the very same problems that led to the trend for liberalisation

Refine energy only markets

- Minimal changes of the “target model”
- Introduce capacity mechanisms and improve balancing markets
- It only addresses part of the problem
  - Does not deal with wider issues of problems with signals for investment, operation etc
- As ancillary services become more important, integration with wholesale and capacity prices gets trickier as does passing price signals passed through to consumers. It would lead at a complex and volatile system still vulnerable to price distortions.

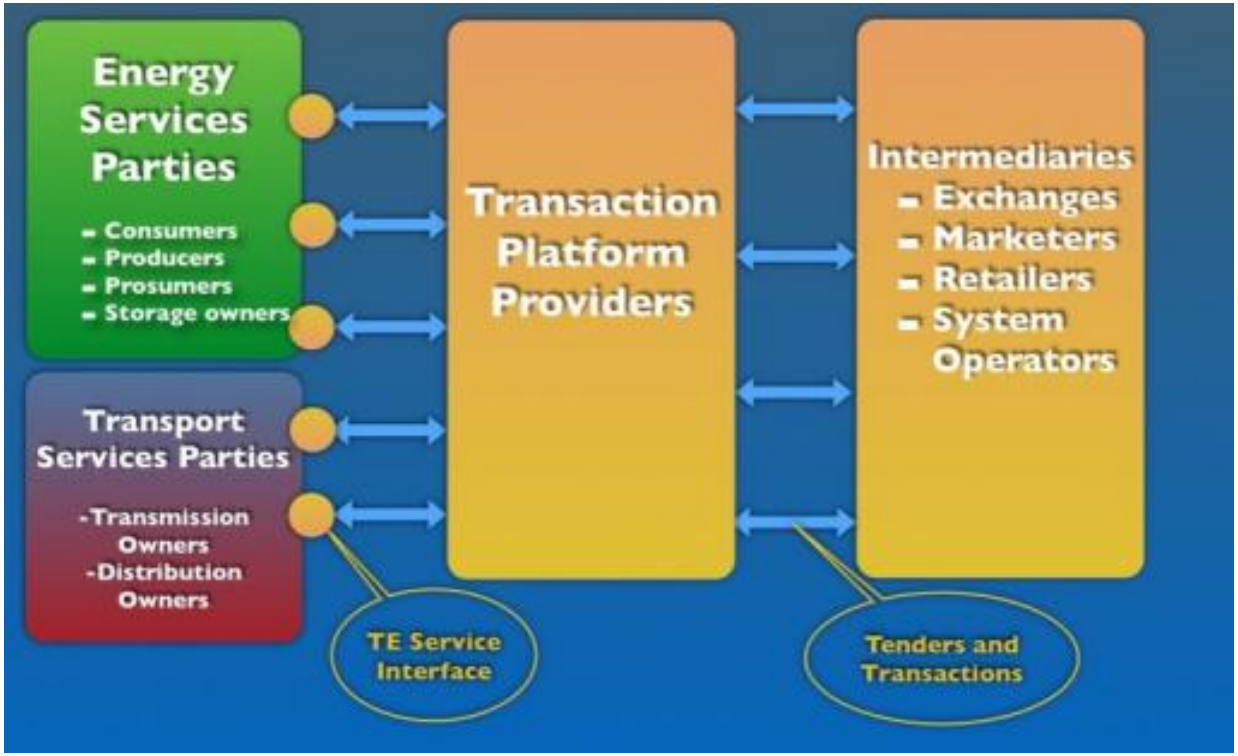
More fixed cost elements

- Logic is that costs are increasingly capital, so support should be given to capacity (kW), not to energy
- Conversely, recovery should be through flat ("capital") rates
- Flat rates based on contracted capacity provide demand side incentives (e.g. to spread demand), and dis-incentivise inefficient distributed generation
- However:
  - Social impact - flat rates tend to be fiscally regressive
  - Incentive effects –leads to minimum capital expenditure, not maximum output
  - It still incentivises supported generation to supply below full cost so does little to remove market distortions.

Transactive Pricing

- Principle: general unbundling of transmission/distribution and energy: two basic products to be traded in spot and forward markets
- All parties (generators, residential and industrial consumers, transmission and distribution companies, system operators) transact energy and transport services.
- Extensive use is made of intelligent autonomous agents
- A huge number of intermediaries and products are expected to develop

Transactive Pricing



Transactive pricing - problems

- Complexity on the demand-side. Even if much is automated, customers might be reluctant to participate. Price volatility is likely, disincentivising investment.
- Unclear how supply-side investment will take place without giving rise to competitive concerns, as it is supposed to happen based on long-term contracts that tend to foreclose the market
- Regulatory intervention is likely to remain (e.g. regulatory pressures in the UK towards simpler tariffs, whereas complex contractual structures are expected under transactive systems)
- It does not address the market distortions caused by massive subsidized capacity

Capacity and investment markets

- Rely on arbitrary centralised judgements about the level of security people want.
- Don’t take advantage of different VOLLs (Values of Lost Load) on the consumer side.
- Don’t involve consumers; pass on price signals in an arbitrary administrative manner.

Investment markets

- Idea is to drive investment via markets at the investment stage; short term markets then deal only with operation.
- Examples: UK FiTs; Latin America supplier purchase markets.
- Problem: how do consumers get a voice?

Capacity Markets

- Designed to guarantee a given level of reliability.
- Traditional view – electricity reliability is a public good (non-excludable) so has to be provided as a public service.
- Different in principle from investment markets, though can be combined.
- Same problem – involving consumers in a meaningful way.

But traditional thinking on capacity requirements is outdated

1. Old view: essential nature of electricity supply.
   - But not all electricity uses are essential, significant tranches can be quite price responsive.
2. Old view: electricity as a network industry, in the sense of non-excludable good.
   - But smart meters and appliances may be used to implement customer specific curtailment responses.
3. Old view: transaction costs of trading reliability too high and demand response too slow.
   - But smart meters and appliances can significantly reduce transaction costs coordination and control problems.
4. Old view: generation is flexible, demand passive.
   - But most new generation is inflexible, demand is increasingly active.

Retail and wholesale prices diverge